Network concept

FIG. 1

FIG. 2A

6,1-Tree

FIG. 2B

Star (=6,1-Tree)

FIG. 2C

Multi-leg Star

FIG. 2D

3,2-Tree

FIG. 2E

2-Mesh (complete)

FIG. 2F

2-Mesh (incomplete)

Mesh and mesh derived network topology examples

36

5 Hops

4 Hops

Sink Node

1 Hop

2 Hops

3 Hops

38 · · · ·

Square Grid

FIG. 3

FIG. 4A
Star

FIG. 4B
Mesh

FIG. 4C
Star+Mesh
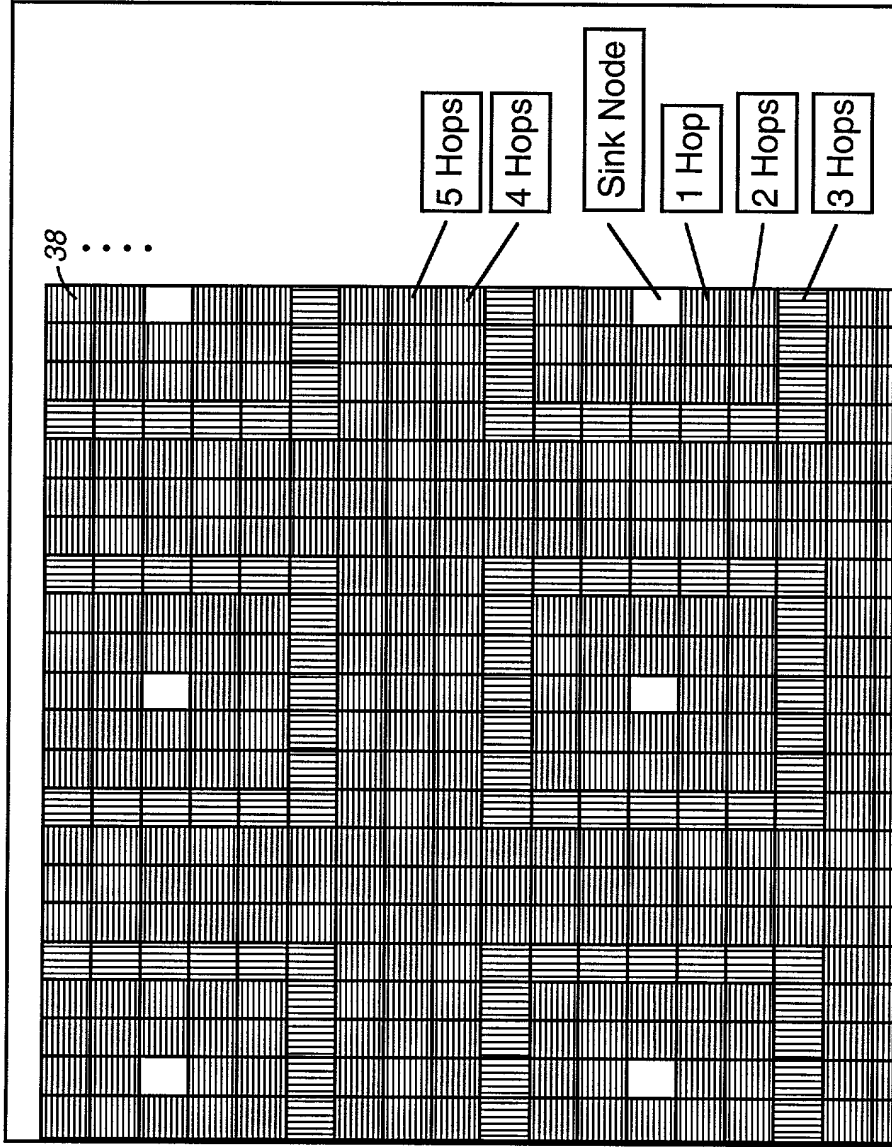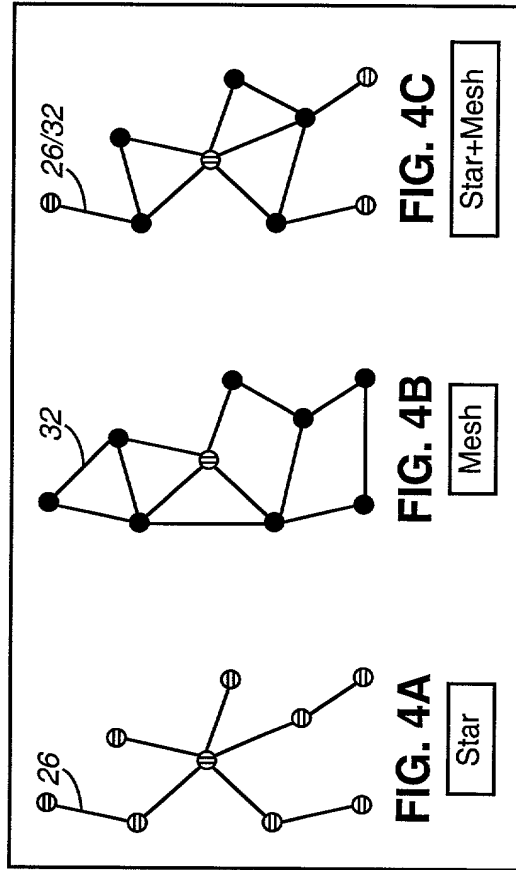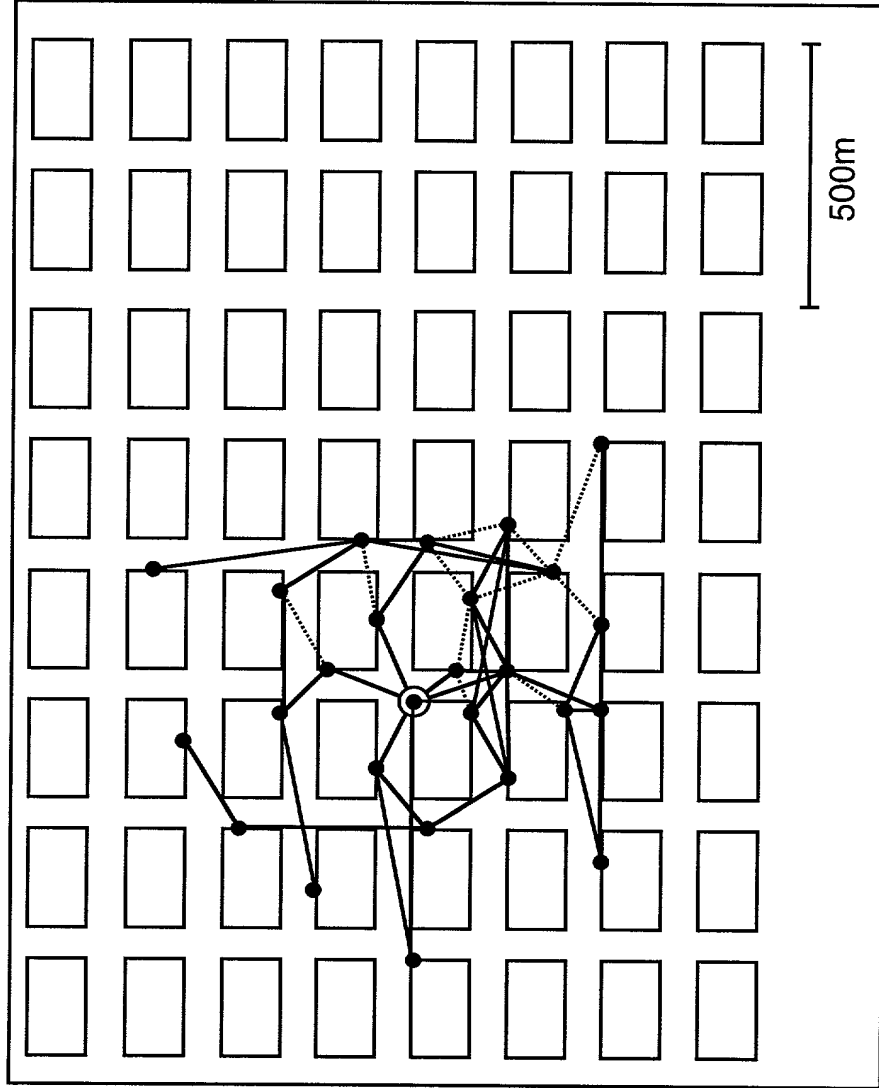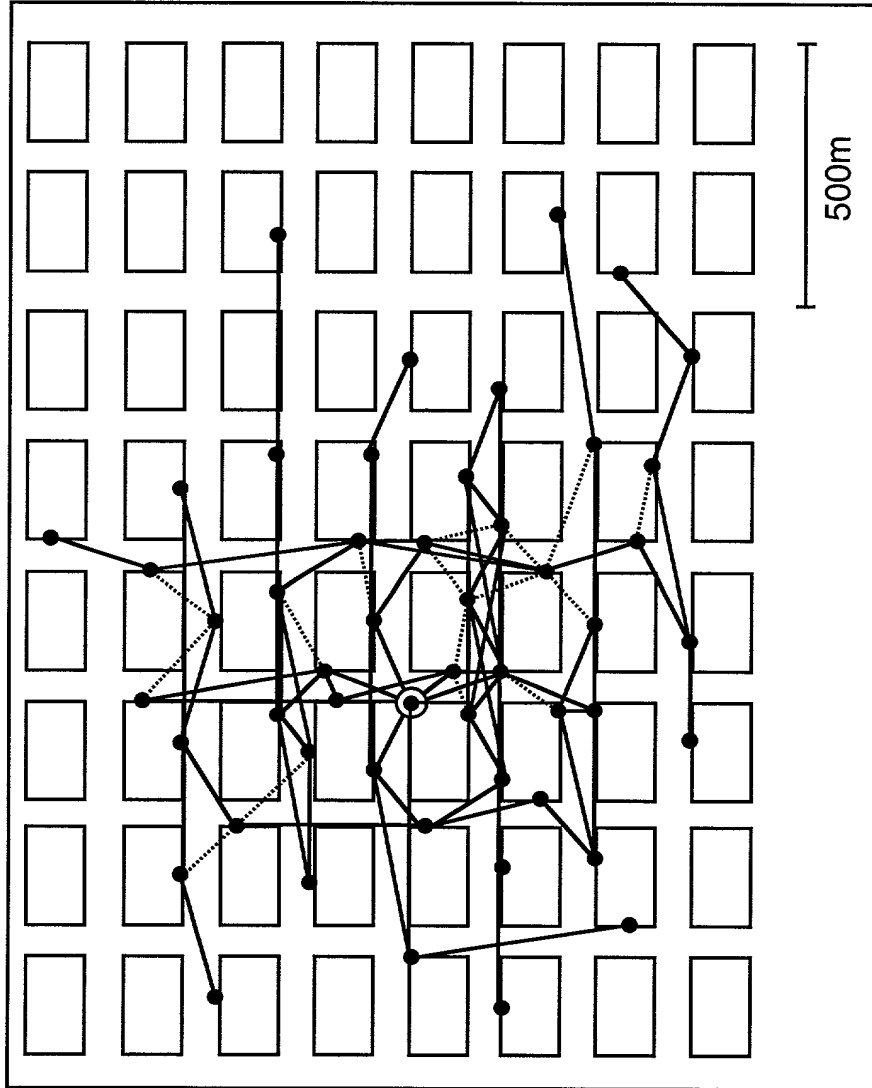
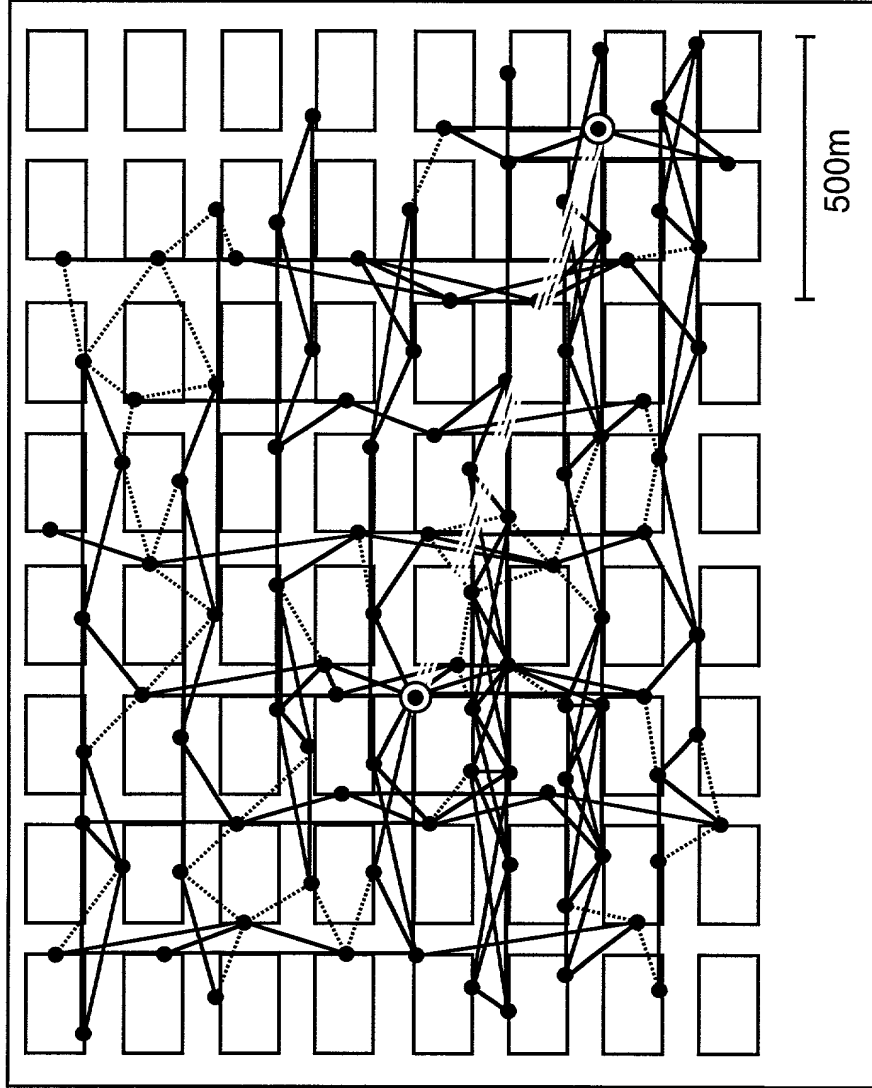Network topologies in the rural case

Ad-hoc Mesh network with 25 customers (all within 5 hops)

FIG. 5

Ad-hoc Mesh network with 50 customers (all within 7 hops)

500m

42

FIG. 6
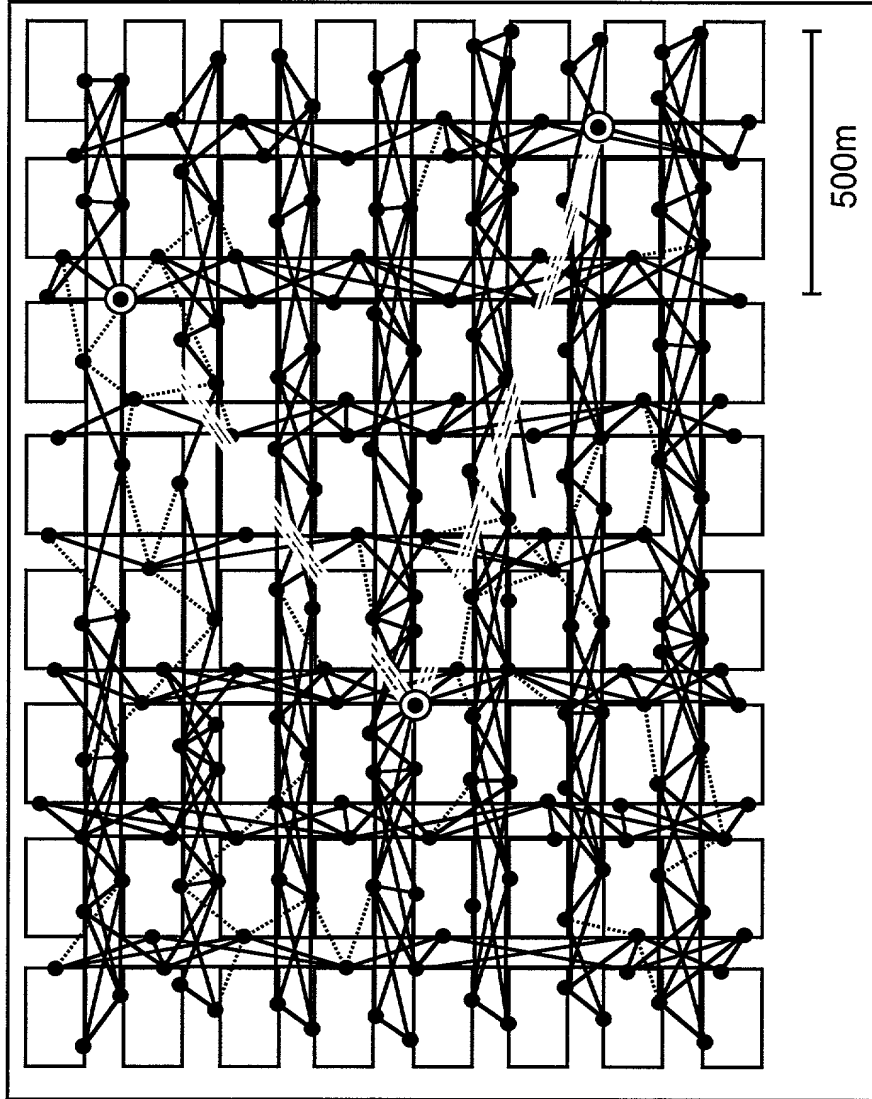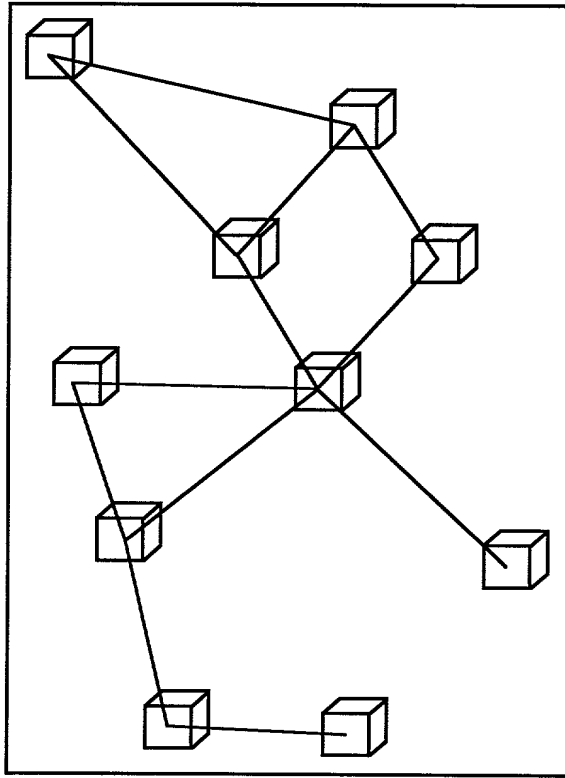
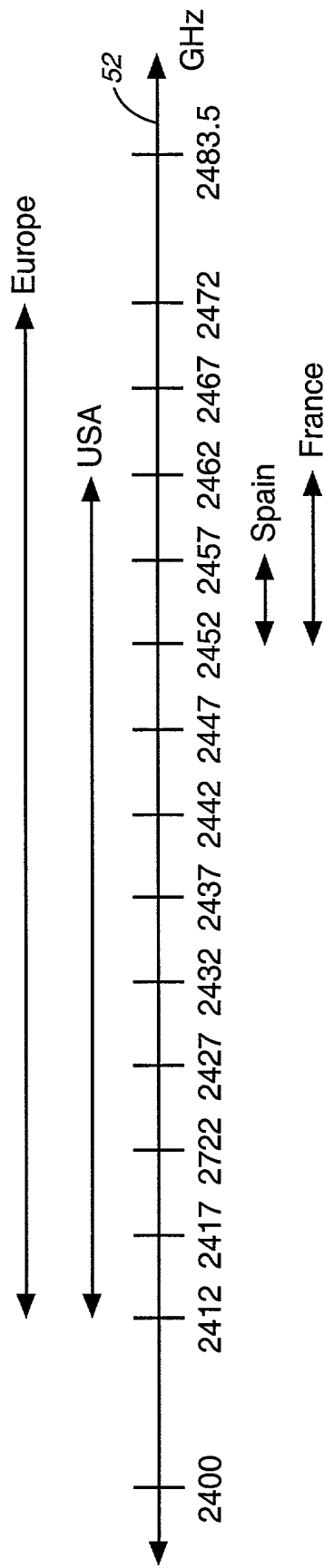Ad-hoc Mesh network with 100 customers (all within 5 hops)

FIG. 7

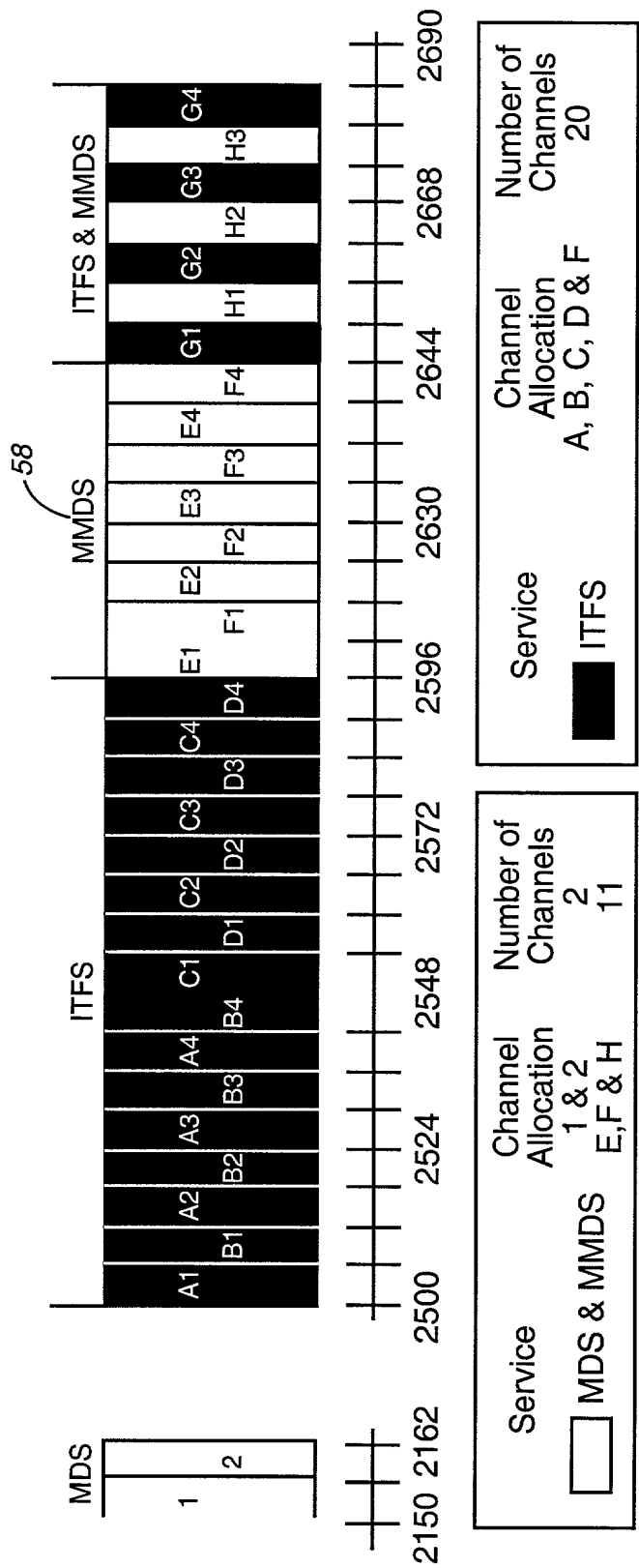Ad-hoc Mesh network with 200 customers (all within 5 hops)
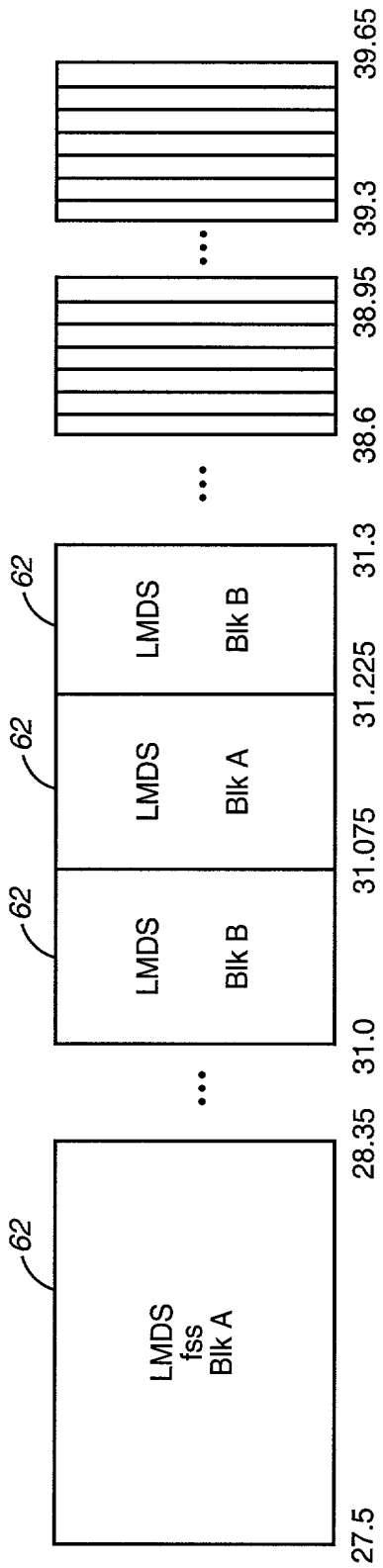
FIG. 8

Mesh network applied in rural case

FIG. 9

ISM band spectrum allocation

FIG. 10

FIG. 11

MMDS bandwidth allocation (USA example)
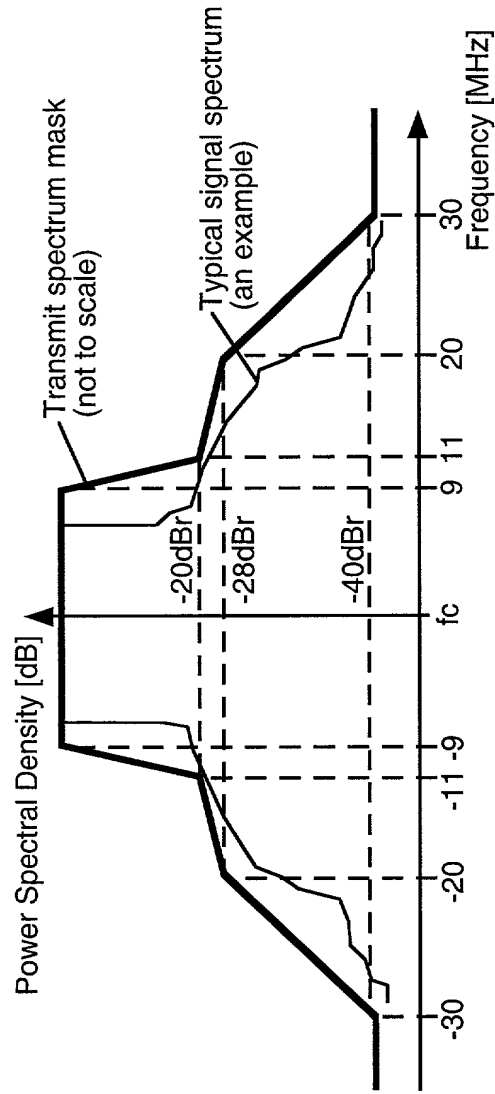
LMDS bandwidth allocation (USA example)

FIG. 12

FIG. 13A

Power Spectral Density [dB]

Transmit spectrum mask (not to scale)

Typical signal spectrum (an example)

-20dBr

-28dBr

-40dBr

fc   -11   -9   9 11   20   30

-30   -20   -9   Frequency [MHz]

FIG. 13B

Transmit Spectrum Mask

0 dBr

Unfiltered Sinx/x

-30dBr

-50dBr

fc -22 MHz   fc -11 MHz   fc   fc +11 MHz   fc +22 MHz
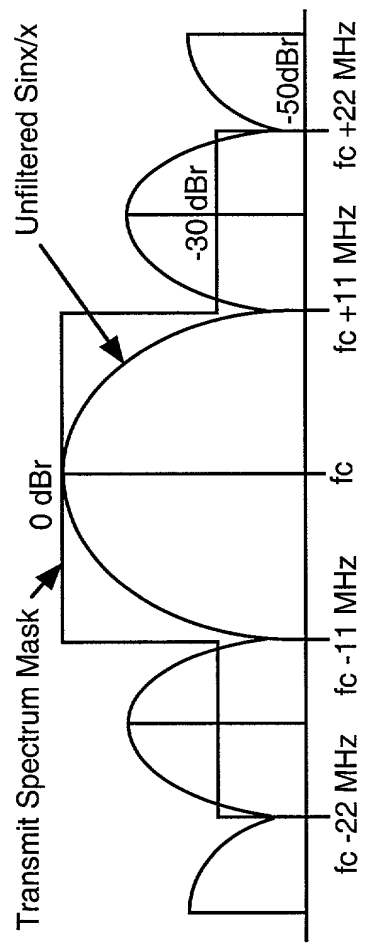
IEEE 802.11 Spectral masks: OFDM (11a) and DSSS (11 and 11b)

Hyperframe H

66

Hyperframe 2

66

Hyperframe 1

66

H Superframes, h s

Superframe S

Superframe 2

Superframe 1

S Frames, s ms

Frame F

Frame 2

Frame 1

f μs

M Data Slots, m μs

N Ctrl Slots, n μs
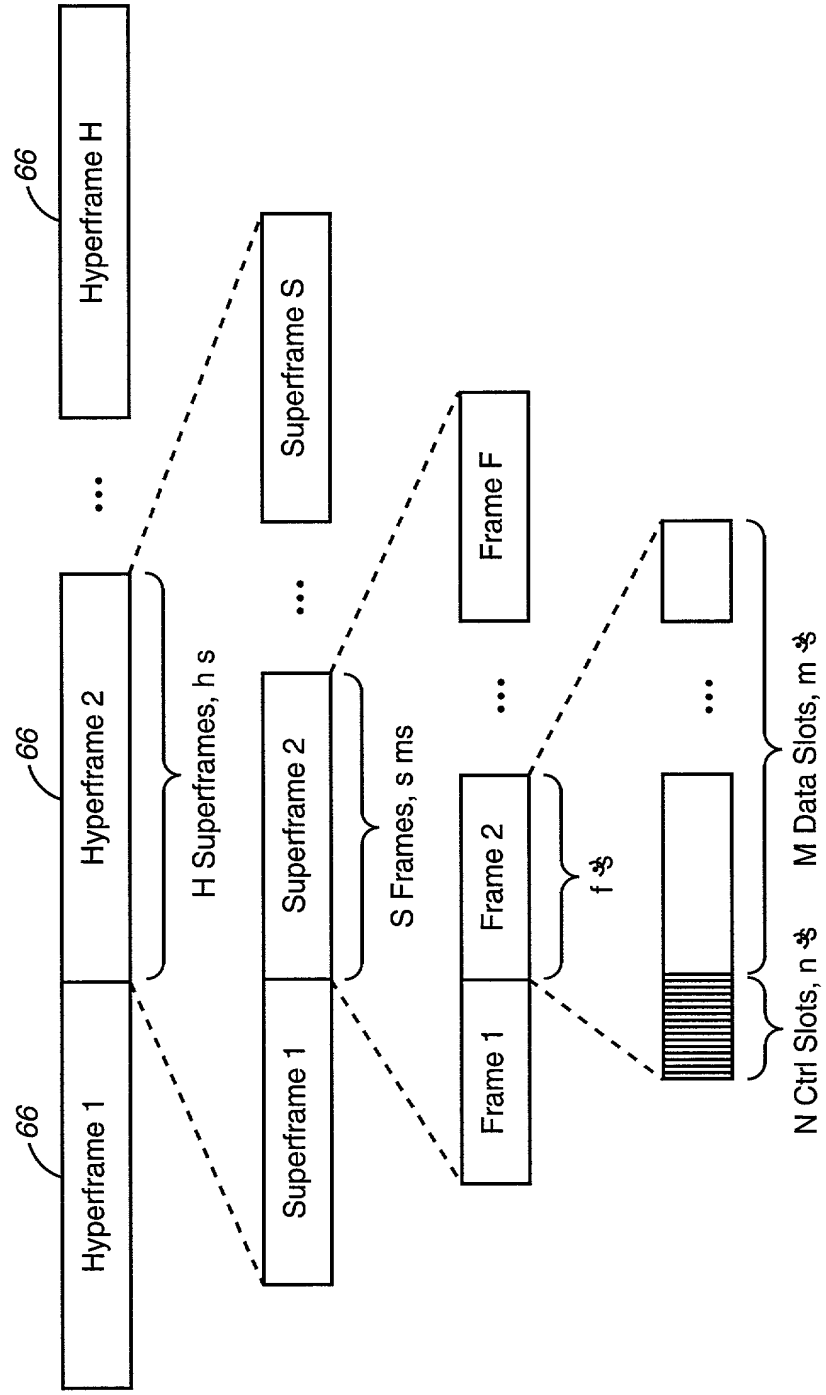
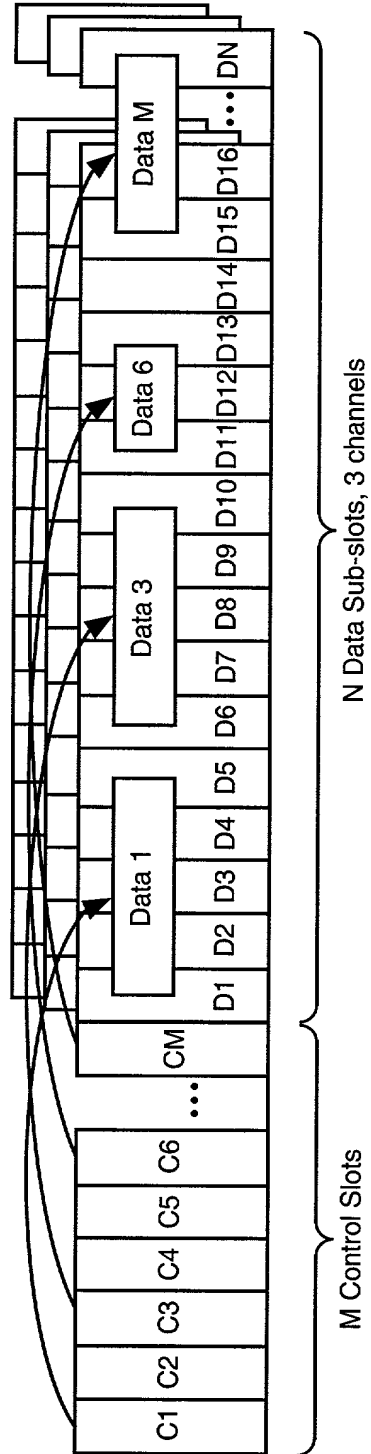Hyper-, Super- and Frame structure

FIG. 14

Neighborhood
(Nodes next to the
examined one)

Extended Neighborhood
(nodes within two hops
from the examined one)
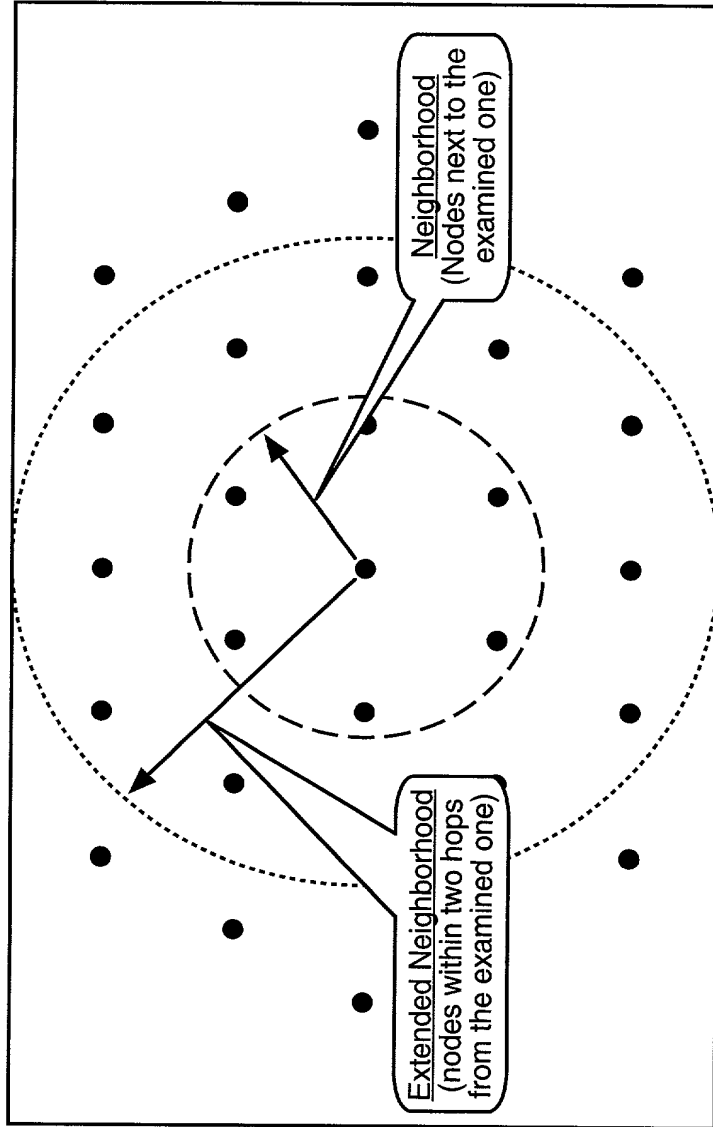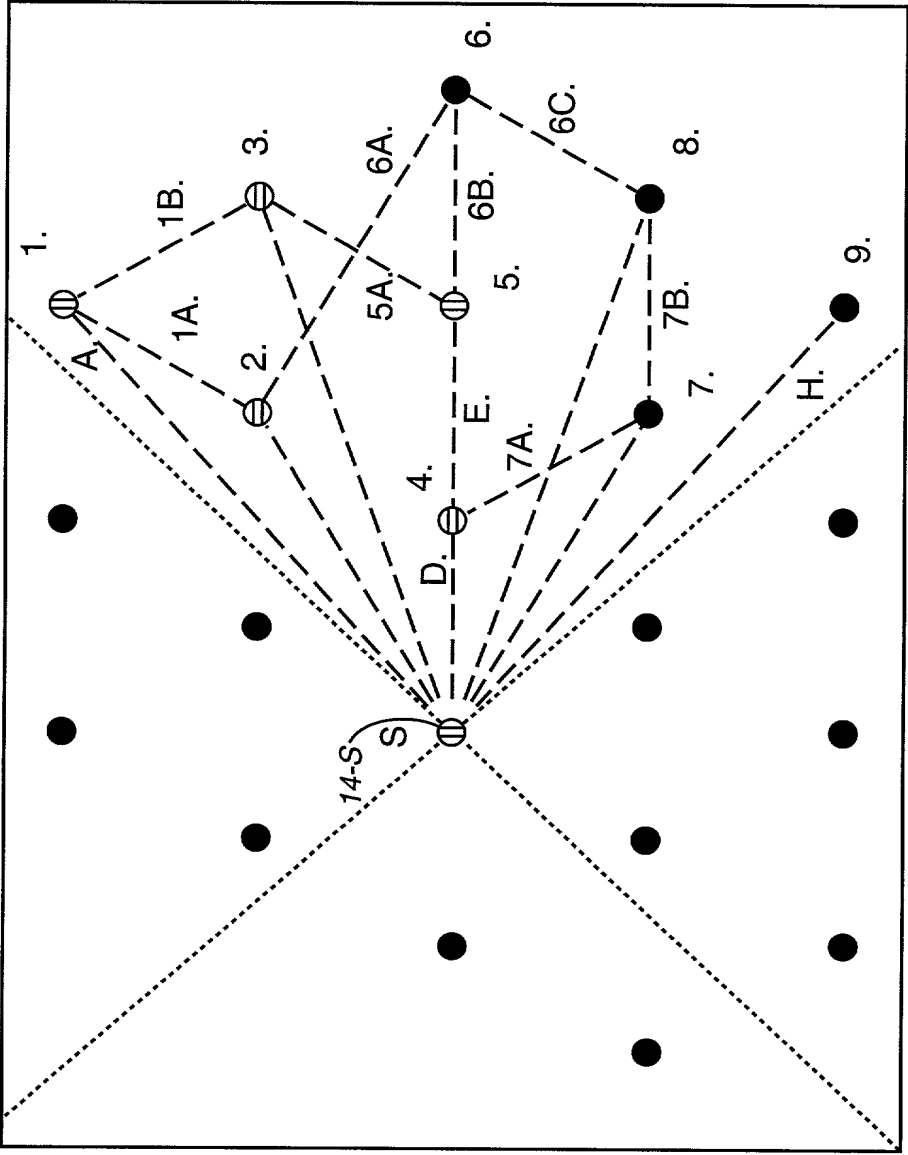
Neighborhood definitions

FIG. 15

M Control Slots

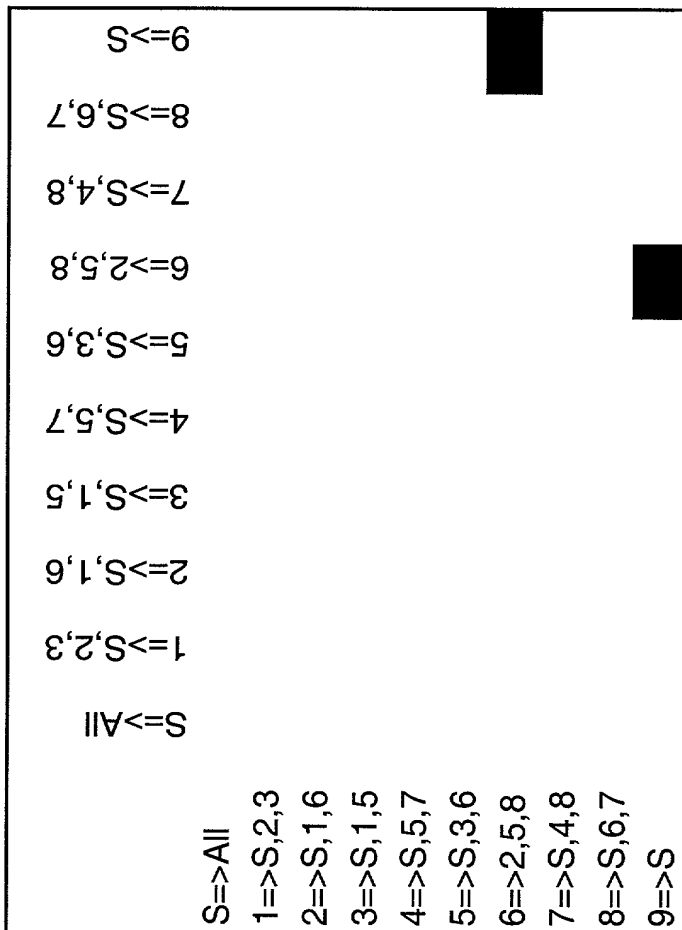N Data Sub-slots, 3 channels

Data slot Reservation example

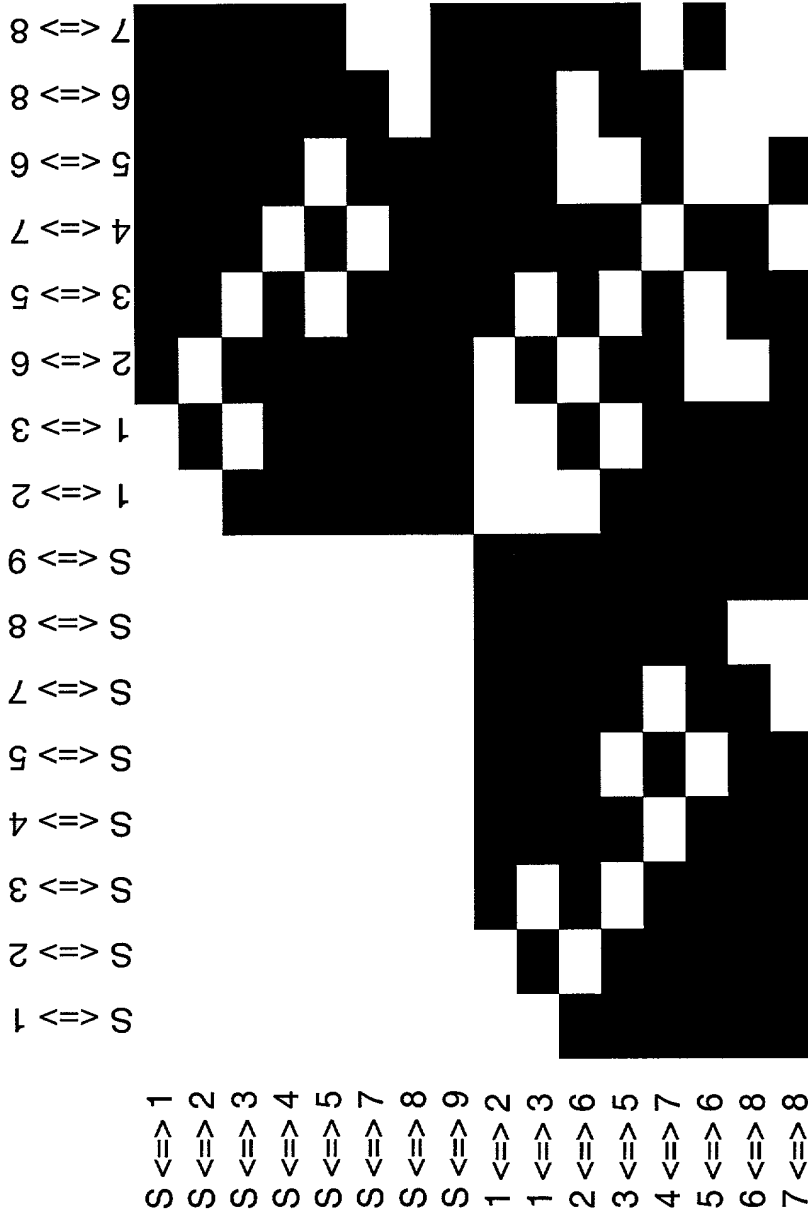**FIG. 16**

PMT Tier with 90□ sectors at the sink (S)

FIG. 17

Multi-cast scheduling (black denotes empty slot)

FIG. 18

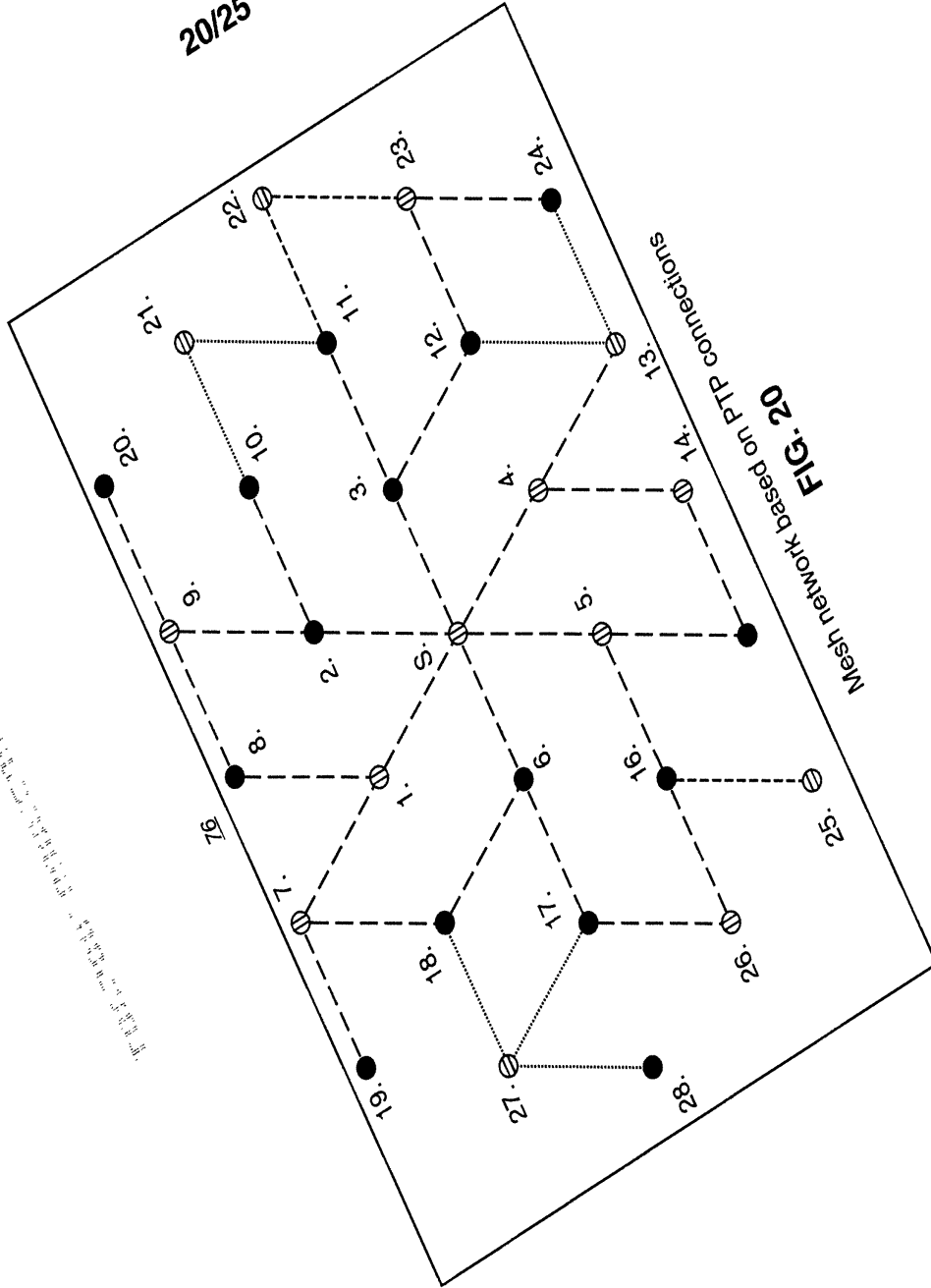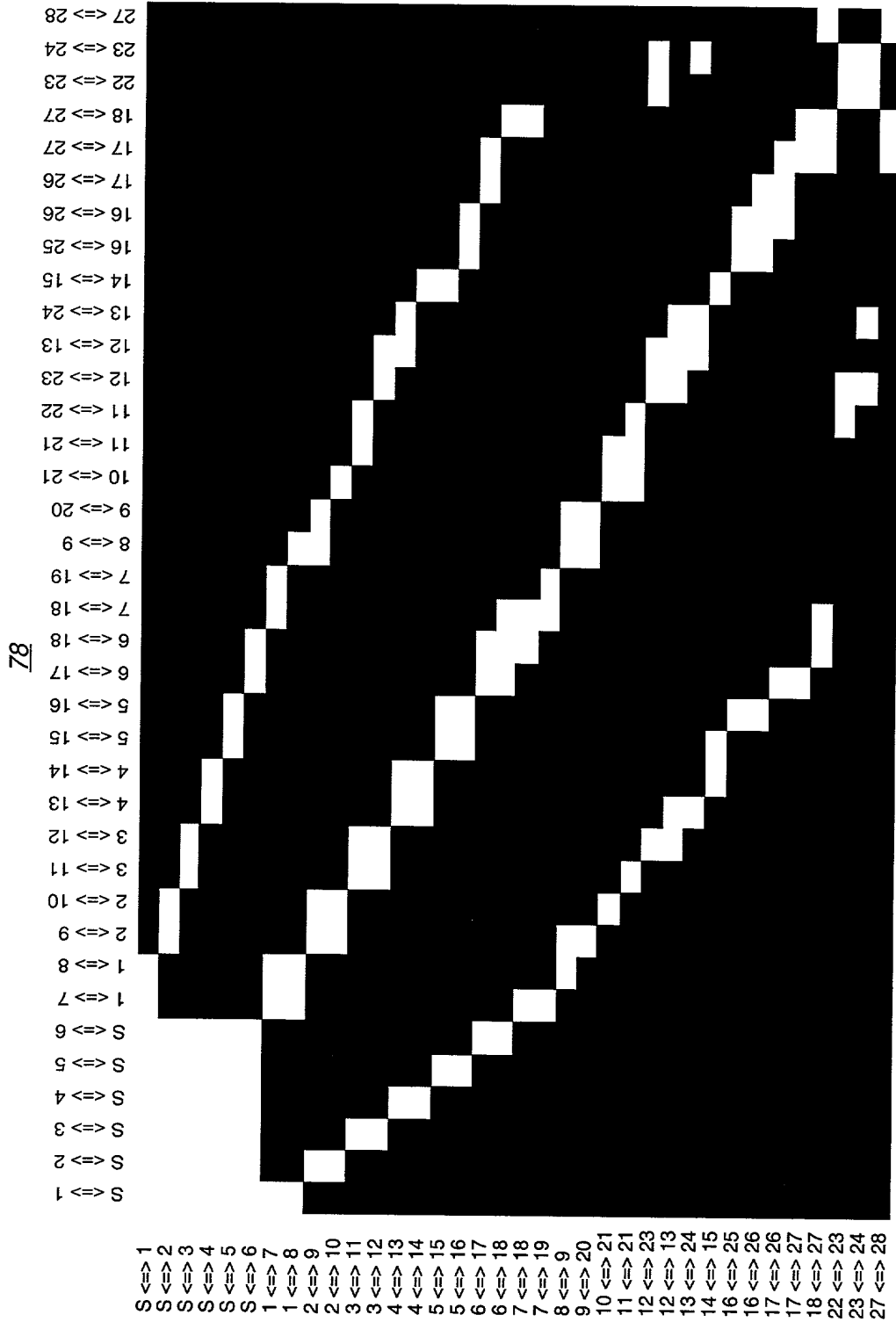Traffic matrix for network in Figure 17 (black denotes slot available for simultaneous transmission)
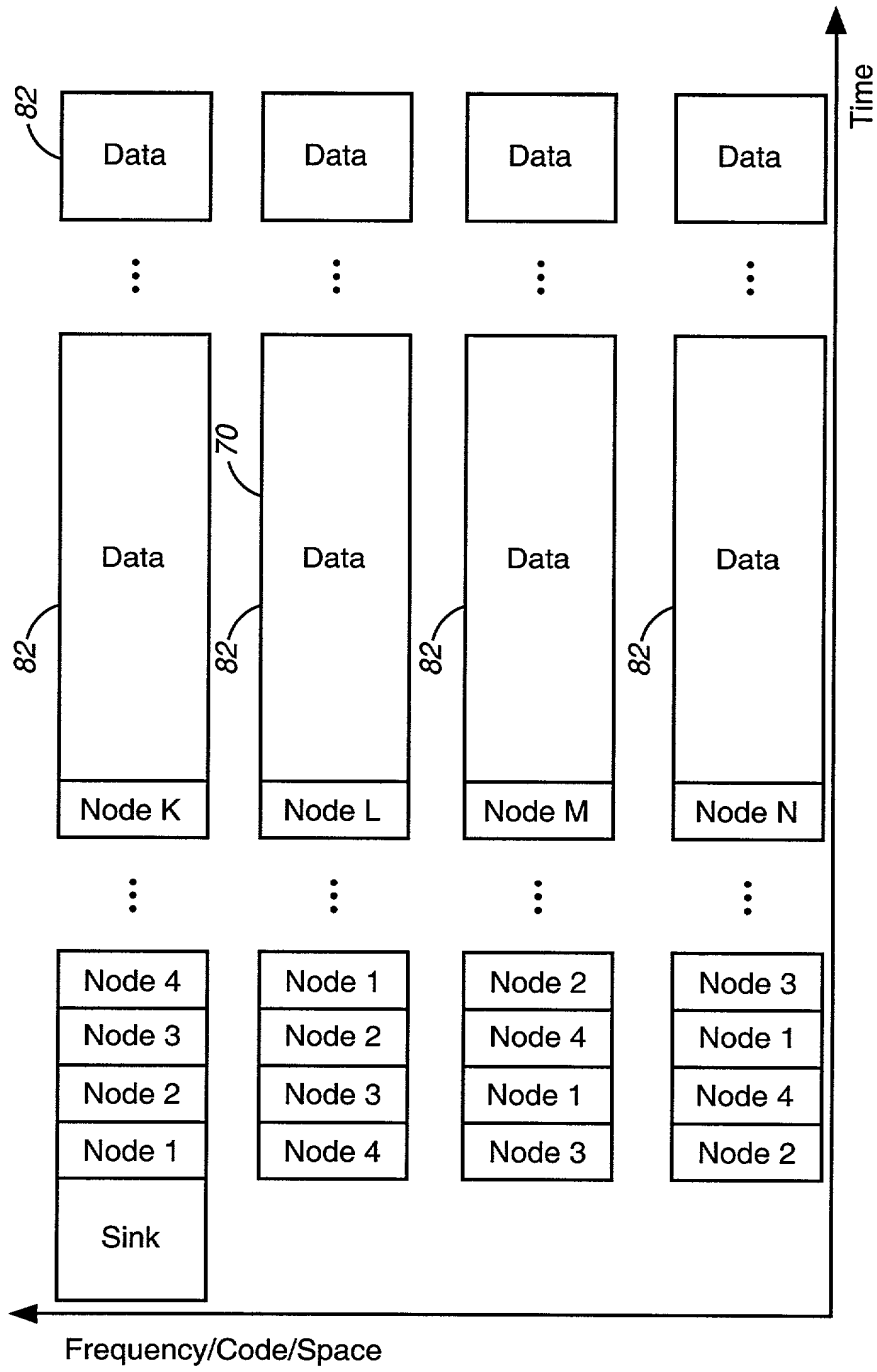
FIG. 19

FIG. 20

Mesh network based on PTP connections

Traffic matrix for network in Figure 20 (black denotes slot available for simultaneous transmission)

FIG. 21
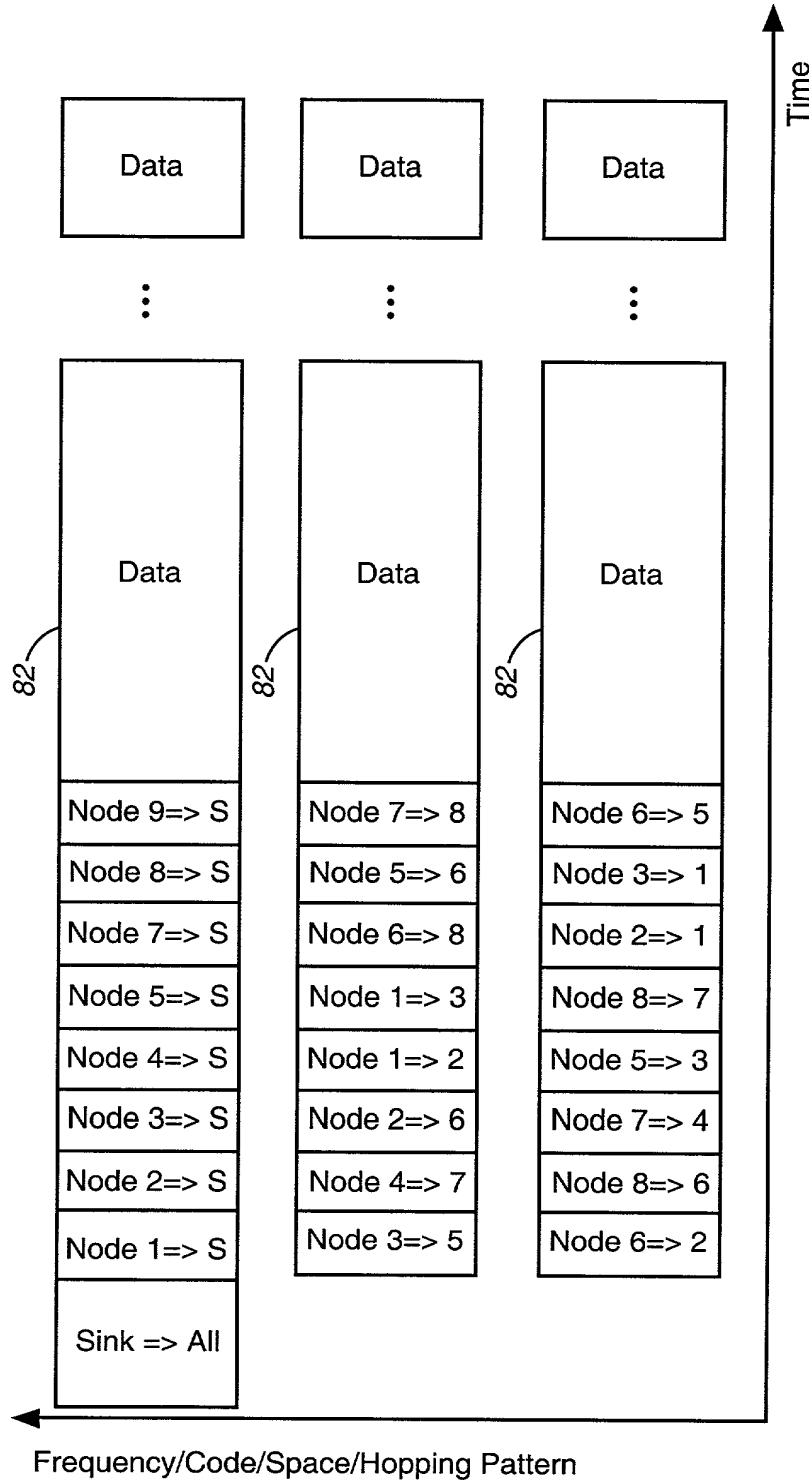
Time

82

| Data | Data | Data | Data |

⋮ ⋮ ⋮ ⋮

82 70 82 82 82

| Data | Data | Data | Data |

| Node K | Node L | Node M | Node N |

⋮ ⋮ ⋮ ⋮

Node 4	Node 1	Node 2	Node 3
Node 3	Node 2	Node 4	Node 1
Node 2	Node 3	Node 1	Node 4
Node 1	Node 4	Node 3	Node 2
Sink			

PMT frame structure

FIG. 22

Frequency/Code/Space

Data	Data	Data

⋮   ⋮   ⋮

Data	Data	Data
Node 9=> S	Node 7=> 8	Node 6=> 5
Node 8=> S	Node 5=> 6	Node 3=> 1
Node 7=> S	Node 6=> 8	Node 2=> 1
Node 5=> S	Node 1=> 3	Node 8=> 7
Node 4=> S	Node 1=> 2	Node 5=> 3
Node 3=> S	Node 2=> 6	Node 7=> 4
Node 2=> S	Node 4=> 7	Node 8=> 6
Node 1=> S	Node 3=> 5	Node 6=> 2
Sink => All		

82 82 82

Time

Frequency/Code/Space/Hopping Pattern

PMT control slot & channel allocation example for network in Figure 17 (assuming narrowbeam antennas at nodes).
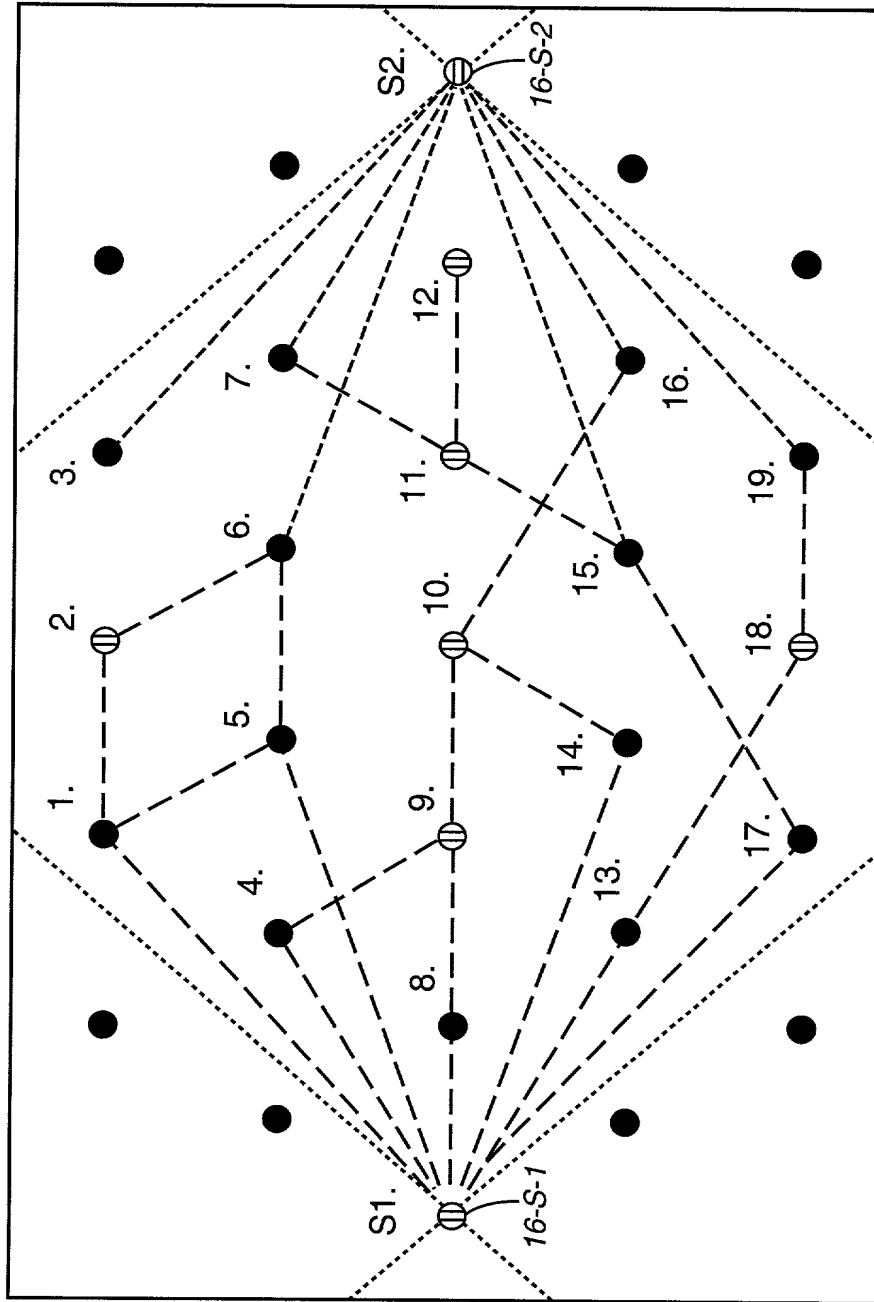
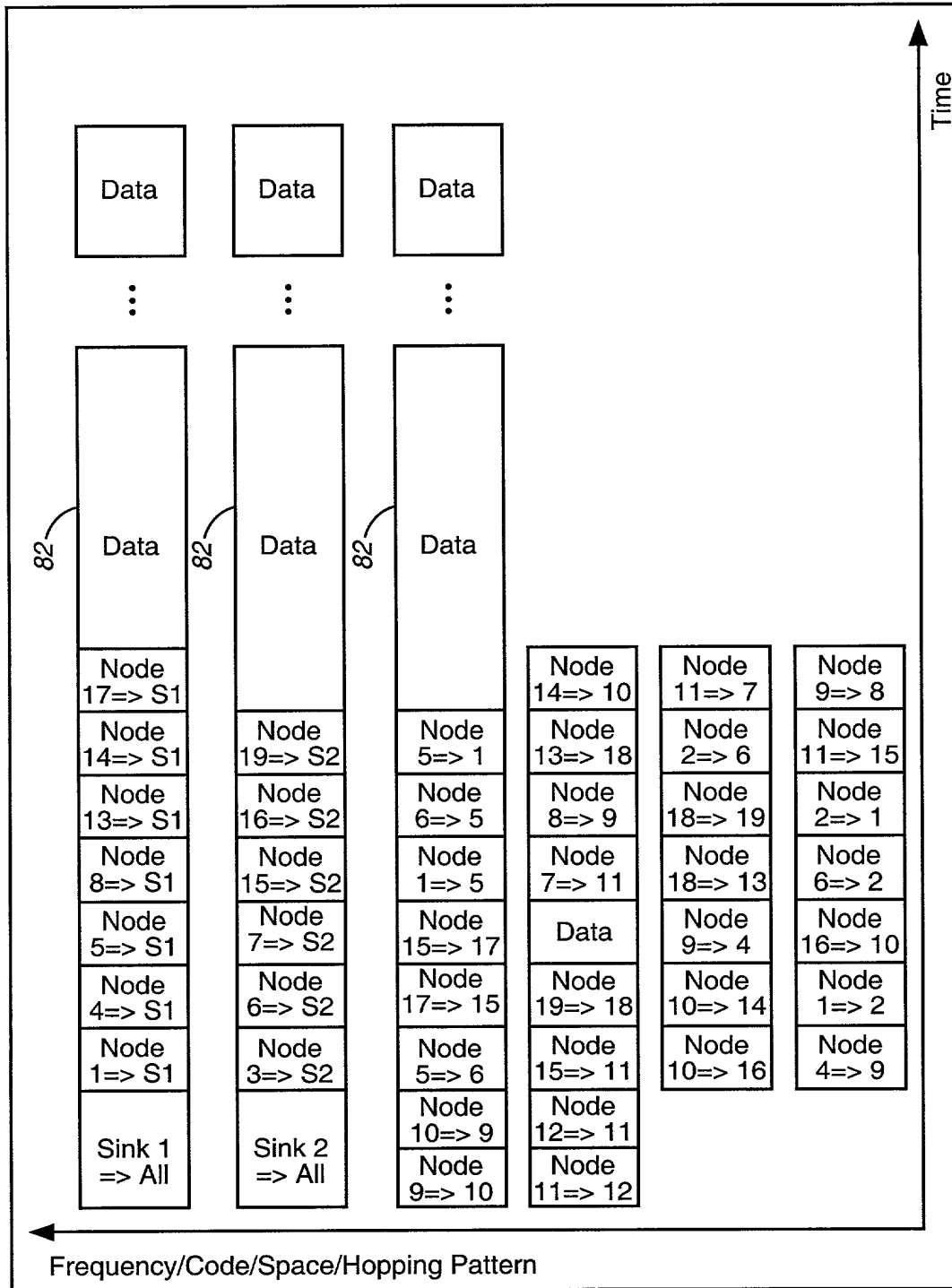**FIG. 23**

A PMT network with two sinks

FIG. 24

FIG. 25

PMT control slot & channel allocation example for network in Figure 17
(assuming narrowbeam antennas at nodes).